DOE/EA-1196

Environmental Assessment
for
Selection and Operation of the Proposed Field Research Centers
for the
Natural and Accelerated Bioremediation Research (NABIR) Program

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U.S. Department of Energy
Office of Science
Office of Biological and Environmental Research

SUMMARY

Background

The U.S. Department of Energy (DOE) Office of Biological and Environmental Research (OBER), within the Office of Science (SC), proposes to add a Field Research Center (FRC) component to the existing Natural and Accelerated Bioremediation Research (NABIR) Program. The NABIR Program is a ten-year fundamental research program designed to increase the understanding of fundamental biogeochemical processes that would allow the use of bioremediation approaches for cleaning up DOE's contaminated legacy waste sites. An FRC would be integrated with the existing and future laboratory and field research and would provide a means of examining the fundamental biogeochemical processes that influence bioremediation under controlled small-scale field conditions. The NABIR Program would continue to perform fundamental research that might lead to promising bioremediation technologies that could be demonstrated by other means in the future.

For over 50 years, DOE and its predecessor agencies have been responsible for the research, design, and production of nuclear weapons, as well as other energy-related research and development efforts. DOE's weapons production and research activities generated hazardous, mixed, and radioactive waste products. Past disposal practices have led to the contamination of soils, sediments, and groundwater with complex and exotic mixtures of compounds. This contamination and its associated costs and risks represents a major concern to DOE and the public.

The high costs, long duration, and technical challenges associated with remediating the subsurface contamination at DOE sites present a significant need for fundamental research in the biological, chemical, and physical sciences that will contribute to new and cost-effective solutions. One possible low-cost approach for remediating the subsurface contamination of DOE sites is through the use of a technology known as bioremediation. Bioremediation has been defined as the use of microorganisms to biodegrade or biotransform hazardous organic contaminants to environmentally safe levels in soils, subsurface materials, water, sludges, and residues. While bioremediation technology is promising, DOE managers and non-DOE scientists have recognized that the fundamental scientific information needed to develop effective bioremediation technologies for cleanup of the legacy waste sites is lacking in many cases. DOE believes that field-based research is needed to realize the full potential of bioremediation.

Purpose and Need

The Department of Energy faces a unique set of challenges associated with cleaning up waste at its former weapons production and research sites. These sites contain complex mixtures of contaminants in the subsurface, including radioactive compounds. In many cases, the fundamental field-based scientific information needed to develop safe and effective remediation and cleanup technologies is lacking. DOE needs fundamental research on the use of microorganisms and their products to assist DOE in the decontamination and cleanup of its legacy waste sites.

The existing NABIR program to-date has focused on fundamental scientific research in the laboratory. Because subsurface hydrologic and geologic conditions at contaminated DOE sites cannot easily be duplicated in a laboratory, however, the DOE needs a field component to permit existing and future laboratory research results to be field-tested on a small scale in a controlled outdoor setting. Such field-testing needs to be conducted under actual legacy waste field conditions representative of those that DOE is most in need of remediating. Ideally, these field conditions should be as representative as practicable of the types of subsurface contamination conditions that resulted from legacy wastes from the nuclear weapons program activities. They should also be representative of the types of hydrologic and geologic conditions that exist across the DOE complex.

Proposed Action and Alternatives

Proposed Action. The proposed action is to select and operate a field research component of the NABIR Program through the use of an FRC. The proposed FRC would consist of contaminated and uncontaminated, i.e., background areas on DOE lands. Within these areas would be small test plots (less than one acre), along with supporting field site trailers and existing laboratory facilities. The areas would serve as the primary field site for small-scale basic bioremediation research activities. The types of activities that could occur at the proposed FRC can be categorized into passive and active site characterization, obtaining research-quality samples, and *in situ* research. Because the activities at the proposed FRC would be undertaken in an area limited to less than an acre and a depth of 75 feet, the scale of research activities would be considered small (for a description of the proposed action at the FRC see Section 2.0 and Appendix A).

Passive subsurface characterization activities are described as non-intrusive (e.g., ground penetrating radar, electromagnetics, and resistivity) and intrusive (e.g., seismic tomography, radar, direct push penetrometer, creation and use of injection/extraction wells). Active characterization can be defined as the addition of some substance (e.g., air, non-toxic chemical tracers such as bromide, or a gas tracer such as helium or neon) to the subsurface under controlled conditions. The FRC would be a primary source for groundwater and sediment samples for NABIR investigators. Obtaining research-quality samples would be critical to the research conducted under the NABIR program at the FRC. Groundwater would be sampled by pumping water from existing wells or by installing new wells.

In situ research (i.e., research occurring in soils and groundwater at the FRC) would include biostimulation and bioaugmentation studies within the test plots. Biostimulation would involve introducing substances (e.g., electron donors and acceptors) into the subsurface to stimulate naturally occurring microorganisms to bioaccumulate or transform a heavy metal or radionuclide. Bioaugmentation would involve the injection of additional microorganisms into the subsurface to either bioaccumulate heavy metals or radionuclides, or transform them such that they become less toxic or less mobile in the subsurface. *In situ* research would only use non-toxic chemicals. There would be no use of genetically engineered microorganisms, no injections of radioactive materials, and no use of human pathogens. With the exception of the proposed placement of temporary work/sample preparation trailers at the test plots, there would be no new construction involved with the operation of the proposed FRC. Existing utilities would be used, and there would be no impacts to these utilities because of the small-scale research being proposed. Heavy equipment (e.g., drill rigs, brush hogs, augers) would be used when necessary for site clearing prior to conducting research at the background or contaminated sites. The equipment would be used for short periods of time. Best management practices and all applicable rules and regulations would be followed during the use of equipment.

Alternatives. This Environmental Assessment (EA) analyzes two alternative sites: Oak Ridge National Laboratory (ORNL)/Y-12 Site, Oak Ridge, Tennessee; and Pacific Northwest National Laboratory (PNNL)/DOE Hanford 100-H Area, Richland, Washington; and No Action. OBER used a systematic three-phased process to identify suitable alternative sites for the location of a proposed FRC. In Phase I, the requirements for an FRC were developed (e.g., the FRC must be located at a DOE site and must have legacy waste produced during research, design and production of nuclear weapons). DOE sites that met the requirements were identified. Eight sites expressed an interest in competing for FRC status: 1) PNNL/Hanford Site, WA; 2) Idaho National Engineering and Environmental Laboratory, ID; 3) Lawrence

Livermore National Laboratory, CA; 4) Los Alamos National Laboratory, NM; 5) Nevada Test Site, NV; 6) ORNL, TN; 7) Sandia National Laboratory, NM; and 8) Savannah River Site, SC. In Phase II, preferred characteristics for the FRC were identified and provided to the DOE sites along with a request for formal proposals. Of the eight candidate sites, only two indicated that they had field locations that met the preferred characteristics. Those two sites submitted proposals that contained scientific/technical, management and cost information. The two FRC candidate sites that met the criteria and had the preferred characteristics for an FRC, and therefore represent the array of reasonable alternative sites for the proposed FRC are:

- Oak Ridge National Laboratory/Y-12 Site, Oak Ridge, Tennessee
- Pacific Northwest National Laboratory/DOE Hanford Site, Richland, Washington.

Due to budget constraints, Phase III of the alternative site identification process involved a peer review of the two DOE sites that submitted scientific/technical proposals to be considered for the first FRC. Based on results of peer review of the scientific/technical proposals, on-site visits, and on the assessment of environmental impacts provided in this EA, DOE's preferred alternative is the ORNL/Y-12 Site. Pending additional funding for the NABIR Program, the PNNL/Hanford Site might be funded as an FRC at some point in the future.

The ORNL/Y-12 Site FRC would include a previously disturbed 243-acre (98-hectares) contaminated area and a 404-acre (163-hectares) uncontaminated background area on the Y-12 Site. Within these areas would be small (less than one acre) test plots where field research would take place. The contaminated area at the PNNL/Hanford 100-H Area would be approximately 2,950 feet long (900 meters) by 2,300 feet wide (700 meters) and consist of about 160 acres of land. There are two proposed uncontaminated background areas at the PNNL/Hanford Site that are smaller in size than the contaminated area. Test plots of approximately one acre would be located within the contaminated area.

The No Action Alternative consists of not implementing a field-based component to NABIR by not selecting or operating an FRC. This would result in continuing the NABIR Program's laboratory-based fundamental research approach as it is currently conducted by OBER, but without the benefit of focused and integrated field testing under actual legacy waste cleanup situations. Specifically, fundamental bioremediation research supported by OBER would not integrate laboratory-based research with field-based research from the FRC site. Laboratory findings would not be field-tested. The No Action Alternative would not satisfy the purpose and need.

Environmental Consequences

General Considerations. This EA analyzes the potential impacts to the environment at the proposed FRC at Oak Ridge, the alternative site at Hanford, and the No Action alternative. This EA bounds the type of work expected to occur at the FRC based on similar work that has occurred in other research programs on DOE and non-DOE sites. Resource areas analyzed include: earth resources; climate and air quality; water resources; ecological resources; archaeological, cultural and historical resources; land use, recreation and visual/aesthetic resources; socioeconomic conditions; human health; transportation; waste control; and environmental justice. Overall, because of the small-scale nature of the proposed field research; the limited potential for impacts to the environment; the OBER environment, safety and health and scientific review processes; and the regulatory and permitting compliance that would be required, no adverse environmental impacts would be anticipated.

With the exception of the proposed placement of temporary work/sample preparation trailers at the test plots, there would be no new construction involved with the operation of the proposed FRC. FRC research activities would not include actions that would change the landscape (e.g., large-area bulldozing, large-scale clearing, or excavation). Activities to support site characterization, to obtain research-quality samples, and to conduct *in situ* research would not impact the environment of the proposed FRC because of the small-scale nature (less than one acre and to a depth of less than 75 feet) of the proposed activities. Drilling to obtain groundwater and other sampling actions would not produce significant amounts of fugitive dust. It is expected that these activities would generate much less dust than normal farming practices in the surrounding areas. Operation of the FRC would use standard, construction best management practices to control erosion, (e.g., silt fences, berms) and water for dust suppression and to control fugitive emissions during drilling and other activities. It is anticipated that these and other construction/drilling management practices would adequately control fugitive emissions of radionuclides and any other air pollutants. Heavy equipment (e.g., drill rigs, brush hogs, and augers) would be used for supporting research at the FRC through maintenance and by preparing the test plots for well and for core samples. The equipment would be used for short periods of time and would not adversely impact the surrounding environments (e.g., habitats and sensitive receptors). Any shipment of hazardous materials to or from an FRC would follow U.S. Department of Transportation Hazardous Materials Regulations. Collection and transportation of samples within the FRC would follow existing DOE procedures and meet all environmental, safety, and health requirements. Existing utilities would be used, and there would be no impacts to the environment or to the availability of these utilities because of the small-scale of research activities proposed.

ORNL/Y-12 Site. Potential impacts of concern from siting and operating the proposed FRC at the ORNL/Y-12 Site include contamination of groundwater and surface water (Bear Creek), impacts to sensitive species and habitats, and exposure of FRC workers from radiological sources at the contaminated FRC areas.

FRC activities to support site characterizations, obtain research-quality samples, and perform *in situ* research would occur away from all surface waters including Bear Creek. Research would take place approximately 100 feet (30 meters) from Bear Creek. Research activities would be temporary and small in scale. Any potential runoff occurring as a result of ground-disturbing activities, coupled with rain events, would be controlled by implementing best management practices such as silt fencing at site-specific research areas within the FRC.

The potential exists that groundwater additives injected as part of *in situ* research at either the background or contaminated areas might pass through groundwater channels to the surface waters of Bear Creek. Small quantities of nontoxic tracers, nutrients, electron donors or acceptors, microorganisms, or other substances might be injected either in the background or contaminated areas of the FRC in accordance with best management practices and close monitoring of environmental conditions. Procedures for minimizing migration of contaminants during drilling and abandonment of boreholes and wells would be developed and described in the FRC management documents. These procedures may include sealing the upper few feet of shallow boreholes with low permeability bentonite or grout and installing conductor casing across the unconsolidated zone and sealing with grout or bentonite prior to drilling to deeper bedrock zones.

Previous studies in the Bear Creek Valley have used dye tracers to study groundwater flow. At downstream points in Bear Creek where the dye emerged, no adverse effects on aquatic life were detected. Bromide tracers injected less than 100 feet from the creek were not detected above background levels in seeps or in Bear Creek. Based on these studies, tracers injected in the contaminated area appear to be greatly diluted, and in at least one case were not detectable in Bear Creek. This dilution, plus the fact that tracers used by the NABIR Program would be nontoxic, would result in no impact to either groundwater or to the surface waters of Bear Creek.

Previous studies also suggest that when nutrients were "added" to the subsurface, the native microbial community structure was changed in the immediate vicinity of the addition, but the changes lasted only as long as the additional nutrients were present. Native microorganisms that would be used most likely would be strains that would be isolated from the contaminated area and then reinjected. Reinjection of native microorganisms would not be expected to be of concern either at the background or contaminated area. Non-native microorganisms might be obtained from some other field site and then injected at both the contaminated and background areas. Previous studies suggest that non-native microorganisms that would be used at the contaminated area would not move any great distance from the point of injection. The concentrations of microorganisms that would be used and the amounts potentially injected would be very small and would not be expected to create impacts to the environment. Non-native microorganisms on a test plot would not be expected to persist in the environment and would not be expected to reach Bear Creek. Genetically engineered microorganisms would not be injected either into the background or contaminated areas.

The only FRC activities expected to occur within floodplain areas would be well-drilling and monitoring (e.g., installation of piezometers). Procedures for preventing migration of contaminants down well boreholes would be developed and described in the FRC management documents. These procedures may include sealing the upper few feet of shallow boreholes with low permeability bentonite or grout and installing conductor casing across the unconsolidated zone and sealing with grout or bentonite prior to drilling to deeper bedrock zones. No structures or facilities would be situated in the floodplain. Movement of heavy equipment through the floodplain would be a temporary occurrence and would not impact the capacity of the floodplain to store or carry water. The negative effects to floodplains from the movement of heavy equipment alone is expected to be negligible. Because FRC research would take place on small test plots (less than one acre), it is anticipated that any wetlands found in potential research areas would be avoided. In addition, the limited ground-disturbing activities associated with FRC research would preclude damage to adjacent wetlands that might be in proximity to selected research areas. A Floodplain Assessment and Statement of Findings for the Y-12 Site Area of Responsibility has been completed, and actions undertaken by investigators would be covered by this assessment (see Appendix D).

Human health effects could potentially result from FRC worker exposure to contaminated soil and groundwater, from occupational hazards associated with site work such as well drilling and core sampling, and from hazards associated with accidental releases of liquid chemicals. Radiological doses to workers were bounded by evaluating a "bounding analysis" scenario, in the absence of any existing data on worker doses for this kind of work in the field. Workers were assumed to spill small amounts of soil (5 grams per year) and groundwater (5 milliliters per year) on themselves during the course of retrieving and processing the core samples. To maximize the potential dose, it was further assumed that the workers did not wash off the contamination, but actually ingested it. For the soil ingestion pathway, the total dose (for all radionuclides) is estimated to be less than 0.01 mrem/year, which is ten thousand times less than the limit of 100 mrem/year allowed for members of the public under Title 10, *Code of Federal Regulations*, Part 835, Section 208. The groundwater ingestion pathway is three times smaller, with a total dose of approximately 0.003 mrem/year. To estimate the total potential risk to workers from this "bounding analysis" exposure scenario, it is further assumed that the workers were exposed during the entire life of the project, which is ten years. The combined annual dose from both the soil and groundwater ingestion pathways is 1.26E-02 mrem per year (9.47E-03 + 3.09E-03). Over the ten-year lifetime of the project, the total dose is ten times that amount, or 1.26E-01 mrem, which yields a lifetime risk of 6.28E-08, or roughly six in one hundred million. There are no expected radiological health risks to workers expected from work on the FRC.

Occupational hazards and industrial accidents, such as those associated with well-drilling/sampling and striking a subsurface structure during drilling, have been very few during previous and similar work in the

Bear Creek Valley. Existing wells would be used to the maximum extent possible during NABIR field work on the FRC, thus the amount of new well-drilling work would be minimal. The potential for health effects from accidents on the FRC is expected to be minimal. The expected low radiological doses and the absence of serious accidents during previous field work in the Bear Creek Valley provides a reasonable yardstick for the expectation of minimal impacts to people and the environment during future NABIR studies.

The small scale of the action and its expected minimal level of environmental consequences for the proposed FRC, should not result in any socioeconomic or environmental justice impacts.

PNNL/Hanford 100-H Site. Potential impacts of concern from siting and operating the proposed FRC at the PNNL/Hanford 100-H Site include contamination of groundwater and surface water (Columbia River) and exposure of FRC workers from radiological sources at the contaminated FRC areas.

FRC activities to support site characterizations, obtain research-quality samples, and perform *in situ* research would occur away from all surface waters including the Columbia River. Research would not occur closer than 200 feet (60 meters) from all surface waters, including the Columbia River. The closest point where injection of materials might occur would be in the contaminated area 200 feet from the Columbia River. Tracer injections at the two proposed background areas would be more than 1,500 feet from the Columbia River and concentrations would be expected to be unmeasurable by the time the tracer had traveled only half that distance. PNNL has proposed to install a series of groundwater extraction wells within each test plot to capture any substances injected into upstream injection wells. These extraction wells would be positioned to intercept groundwater flow moving toward the Columbia River. In addition, PNNL could make use of a secondary containment system of existing extraction wells located within 150 feet of the Columbia River to ensure that substances injected as part of *in situ* research by NABIR investigators do not reach the Columbia River. The existing extraction wells are part of an on-going Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Interim Remedial Action that involves pumping and treating for chromium-contaminated groundwater. Filters to extract tracers, electron donors and acceptors, nutrients, microorganisms and other substances would be added to the existing well filtration system, as needed. The pump and treat extraction wells have been operating constantly and will continue to do so. The use of nontoxic and non-persistent tracers coupled with the proposed and existing extraction well systems would ensure that tracers would not reach the Columbia River.

Research activities on the FRC that might disturb the land would be temporary and small in scale; e.g., injecting a small quantity of native microorganisms into the background and contaminated areas of the proposed FRC. Native microorganisms would most likely be strains that would be isolated from the contaminated area and reinjected. Reinjection of native microorganisms would not be expected to be of concern either at the background or contaminated area. Non-native microorganisms would not be injected either at the background or contaminated areas. Similarly, genetically engineered microorganisms would not be used either at the background or contaminated areas. Any potential runoff occurring as a result of ground-disturbing activities, coupled with rain events, would be reduced by implementing best management practices such as silt fencing at site-specific research areas within the FRC.

No structures or facilities would be constructed in the floodplain. Movement of heavy equipment through the floodplain would be a temporary occurrence and would not impact the capacity of the floodplain to store or carry water. The negative effects to floodplain from the movement of heavy equipment alone is expected to be negligible. To the extent practicable, staging areas and access roads would be temporary, construction would be limited to periods of low precipitation, and stabilization and restoration of the affected areas would be initiated promptly. Wetlands in association with the Columbia River occur on the banks of the Columbia in proximity to the proposed contaminated area and background area. These wetlands are small in scale and are generally associated with the immediate bank of the Columbia River. Proposed FRC research would not occur in proximity to the wetlands and would not impact them.

Human health effects could potentially result from FRC worker exposure to contaminated soil and groundwater, from occupational hazards associated with site work such as well drilling and core sampling, and from hazards associated with accidental releases of liquid chemicals. Radiological doses to workers were bounded by evaluating a "bounding analysis" scenario, in the absence of any existing data on worker doses for this kind of work in the field. Workers were assumed to spill small amounts of soil (5 grams per year) and groundwater (5 milliliters per year) on themselves during the course of retrieving and processing the core samples. To maximize the potential dose, it was further assumed that the workers did not wash off the contamination, but actually ingested it. For the soil ingestion pathway, the total dose (for all radionuclides) is estimated to be less than 0.01 mrem/year, which is ten thousand times less than the limit of 100 mrem/year allowed for members of the public under Title 10, *Code of Federal Regulations*, Part 835, Section 208. The groundwater ingestion pathway is three times smaller, with a total dose of approximately 0.003 mrem/year. To estimate the total potential risk to workers from this "bounding analysis" exposure scenario, it is further assumed that the workers were exposed during the entire life of the project, which is ten years. The combined annual dose from both the soil and groundwater ingestion pathways is 1.26E-02 mrem per year (9.47E-03 + 3.09E-03). Over the ten-year lifetime of the project, the total dose is ten times that amount, or 1.26E-01 mrem, which yields a lifetime risk of 6.28E-08, or roughly six in one hundred million. There are no expected radiological health risks to workers expected from work on the FRC.

Occupational hazards and industrial accidents, such as those associated with well-drilling/sampling and striking a subsurface structure during drilling, have been very few during previous and similar work the at the Hanford Site. Existing wells would be used to the maximum extent possible during NABIR field work on the FRC, thus the amount of new well-drilling work would be minimal. The potential for health effects from accidents on the FRC is expected to be minimal. The expected low radiological doses and the limited number of accidents during previous field work at the Hanford Site provide a reasonable yardstick for the expectation of minimal impacts to people and the environment during future NABIR studies.

No Action. Under the No Action alternative, there would be no FRC at the Oak Ridge or Hanford sites. As a result, DOE would not be able to conduct integrated field-based research and no intrusive actions would be taken by the NABIR Program, resulting in no impacts to the affected environment at Oak Ridge and Hanford.

Stakeholder Involvement

In January 2000, DOE provided the Federal, State, and local government agencies, the local communities, and Tribes with the draft EA for a 30-day review. There were no comments from the Tribes or community members and the comments received from the Federal and State and local government agencies were addressed in this final EA. Appendix B provides a list of commentors, their comments, and the location within the EA where each comment is addressed.

LIST OF FIGURES

Title **Page**

LIST OF ACRONYMS AND ABBREVIATIONS

BASIC	Bioremediation And Its Societal Implications and Concerns
BCBG	Bear Creek Burial Grounds
BCV	Bear Creek Valley
BJC	Bechtel Jacobs Company, Limited Liability Corporation
BMP	Best Management Practice
BY/BY	Boneyard/Burnyard
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	U.S. Code of Federal Regulations
DOE	U.S. Department of Energy
DOT	Department of Transportation
EA	Environmental Assessment
EFPC	East Fork Poplar Creek
EH	DOE Office of Environment, Safety and Health
EIS	Environmental Impact Statement
EM	DOE Office of Environmental Management
EMWMF	Environmental Management Waste Management Facility
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ES&H	Environment, Safety and Health
ETF	Effluent Treatment Facility
ETTP	East Tennessee Technology Park
FA	Functional Area
FONSI	Finding Of No Significant Impact
FRAP	Field Research Advisory Panel
FRC	Field Research Center
FY	Fiscal Year
GEM	Genetically Engineered Microorganism
GPR	Ground Penetrating Radar
HASP	Health And Safety Plan
HEHF	Hanford Environmental Health Foundation
LLBG	Low Level Burial Grounds
LLW	Low Level Waste
NAAQS	National Ambient Air Quality Standards
NABIR	Natural and Accelerated Bioremediation Research Program
NEPA	National Environmental Policy Act

NERP	National Environmental Research Park
NRHP	National Register of Historic Places
NESHAP	National Emissions Standard for Hazardous Air Pollutants
OBER	DOE SC's Office of Biological and Environmental Research
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Administration
PM	Particulate Matter
PNL	Pacific Northwest Laboratory, before c.1995
PNNL	Pacific Northwest National Laboratory, after c.1995
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SC	DOE Office of Science
SCFA	Subsurface Contaminants Focus Area
SSP	DOE’s Subsurface Science Program
STEFS	Short-Term Experimental Field Sites
SWTP	Sanitary Waste Treatment Plan
TDEC	Tennessee Department of Environment and Conservation
TSCA	Toxic Substances Control Act
TVA	Tennessee Valley Authority
VOC	Volatile Organic Compound
WAC	Washington Administrative Code
WETF	West End Treatment Facility